5462 5456
Rule126 5449. (New) The method of claim 5445, further comprising maintaining a temperature within the part within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C.

5463 5456
5450. (New) The method of claim 5445, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

5464 5456
C10 5451. (New) The method of claim 5445, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

5465 5456
5452. (New) The method of claim 5445, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

5466 5458
5453. (New) The method of claim 5445, wherein the part of the formation comprises a selected section.

Response To Office Action Mailed April 18, 2002

A. Pending Claims

Claims 2270-2308 and 5396 have been rejected. Claims 2270-2276, 2279, 2281, 2293, 2304, 2306-2308, and 5396 have been amended. Claims 5397-5453 are new. Claims 2270-2308 and 5396-5453 are pending in the case.

B. Examiner Interview

Applicant's undersigned attorney attended an interview with the Examiner and other personnel on August 19, 2002. In the interview all of the cited art, and certain other prior art (e.g., Ljungstrom) was discussed. In addition, the rejections set forth in the office action, and the claims were discussed. Claim amendments were also discussed. Applicant sincerely appreciates the Examiner taking the time to discuss the case.

C. Election of Species

In item 1 of the Office Action, the Examiner states: "Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable." Applicant elects the species of heater described at least in claim 2276, without traverse. The generic name of the elected species is: "natural distributed combustor."

Applicant respectfully submits that the currently pending claims (including the new claims) do not contain non-elected subject matter. Applicant reserves the right for consideration of claims to additional species written in dependent form upon allowance of a generic claim.

D. The Claims Are Definite Pursuant To 35 U.S.C. § 112, Second Paragraph

The Examiner rejected claims 2285-2288 and 2293 under 35 U.S.C. § 112, second paragraph, "as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention."

The Examiner states claims 2285-2288 and 2293 "are indefinite because, insofar as a "hydrocarbon", by definition, comprises organic compounds consisting only of carbon and hydrogen, the recited "condensable hydrocarbons" cannot include nitrogen, oxygen, sulfur and/or oxygen-containing compounds." Applicant respectfully disagrees.

Applicant respectfully submits that Applicant has used an accepted meaning of the term

"hydrocarbon" as defined by one of ordinary skill in the art. Support for this definition can be found in references within and associated with the art of the petroleum industry. For example, a reference within the art gives the following definition: "**Hydrocarbons**: molecules formed primarily by carbon and hydrogen atoms" (Hyne, N. J. *Geology for Petroleum Exploration, Drilling, and Production*, 1984, McGraw-Hill Book Company, pg. 264). The Specification (page 30, paragraph beginning on line 1) has been amended for clarification. Applicant therefore respectfully requests removal of the rejection of Applicant's definition of the term "hydrocarbon".

E. Provisional Double Patenting Rejection

The Examiner provisionally rejected claims 2270-2272, 2276-2308, and 5396 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 2270-2308 of copending U.S. Patent Application No. 09/841,284. Applicant respectfully disagrees that the claims of these applications would raise double patenting issues.

Applicant respectfully traverses the provisional double patenting rejection. Applicant respectfully submits that the omnibus nature of this rejection does not provide Applicant with sufficient detail in which to address such rejection. Applicant also respectfully submits that the rejection is also inconsistent with certain restrictions issued in the above-referenced cases. Applicant respectfully requests reconsideration.

Pursuant to the discussion in the Examiner interview on August 19, 2002, for the convenience of the Examiner, Applicant will forward copies of allowed claims for the above-referenced cases to the Examiner. Applicant understands that the Examiner will review the allowed claims for the above-referenced cases and then reconsider the double patenting rejection in view of such allowed claims.

F. The Claims Are Not Anticipated By Herzog Pursuant To 35 U.S.C. § 102(b)

The Examiner rejected claims 2270, 2272, 2276, and 2304 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 2,906,340 to Herzog (hereinafter "Herzog"). Applicant respectfully disagrees.

The standard for "anticipation" is one of fairly strict identity. To anticipate a claim of a patent, a single prior source must contain all the claimed essential elements. *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 U.S.P.Q.81, 91 (Fed.Cir. 1986); *In re Donahue*, 766 F.2d 531, 226 U.S.P.Q. 619, 621 (Fed.Cir. 1985).

Amended claim 2270 describes a combination of features including: "allowing the heat to transfer from one or more heaters to a selected section of the formation such that a porosity of a majority of at least a portion of the selected section increases substantially uniformly." Applicant submits that Herzog does not appear to teach or suggest the combination of features in claim 2270, including, but not limited to, the above quoted feature.

In the Office Action, the Examiner states: "Herzog (col. 3, lines 28-62) clearly teaches that the in situ combustion of the formation increases the porosity thereof. The region of in situ combustion initiated and effected in the formation (15) is deemed to comprise a "heat source", as broadly recited in claim 2270."

But, Herzog only states: "That portion of the petroleum producing formation swept by the high temperature combustion zone will exhibit improved porosity and/or permeability values with respect to the production of petroleum therethrough." (Herzog, column 3, lines 34-38). Herzog further states:

> It is also believed that some thermal fracturing of the formation swept or otherwise influenced by the high temperature reaction zone will also be accomplished, e.g., by sheer expansion of the formation along formation discontinuities and the like, leading to fractures and fissures and increasing the porosity of the formation in the portion swept by the in situ combustion.
> (Herzog, column 3, lines 42-48).

Thus, Herzog does not appear to teach allowing the heat to transfer from the one or more heaters to a selected section of the formation such that a porosity of a majority of at least a portion of the selected section increases substantially uniformly. Applicant submits that Herzog does not appear to teach all of the features in claim 2270 and the claims dependent thereon.

Claim 5427 describes a combination of features including: "providing heat from one or more heaters to at least a portion of the formation, wherein one or more heaters provides a heat output of less than about 1650 watts per meter; and allowing the heat to transfer from the one or more heaters to a part of the formation such that a porosity of a majority of at least a portion of the part increases substantially uniformly." Applicant submits claim 5427 is supported by Applicant's specification on at least pages 39, 40, 74, 88, 98, 103, 109, and 113. Applicant submits that Herzog does not appear to teach at least the above quoted feature of claim 5427, in combination with the other features of the claim.

Applicant's specification states that: "[a] "heat source" is generally defined as any system configured to provide heat to at least a portion of a formation." (Specification, page 39, lines 16-17). Applicant's specification further states: "A heat source may also include a heater that may be configured to provide heat to a zone proximate to and/or surrounding a heating location such as a heater well." (Specification, page 40, lines 1-2). In addition, "A "heater" is generally defined as any system configured to generate heat in a well or a near wellbore region." (Specification, page 40, lines 6-7).

Herzog discloses:

> Explanatory of in situ combustion as employed in the practice of this invention, a high temperature zone is established in the petroleum producing formation in the vicinity of the well bore by suitable heating means. Suitable heating means may comprise an electrical heating device or a gas fired bottom hole igniter or heater. ...Upon introducing a combustion-supporting or an oxygen-containing gas such as air into the petroleum producing formation via the well bore a high temperature combustion or reaction zone created by the reaction between the oxygen and combustible residues within the formation, ... will commence to move into the formation outwardly from the well bore.
>
> Leaving this high temperature zone is a relatively high temperature gas

> stream which, as it moves outwardly into the formation, losses [sic] heat to the formation. By this method the high temperature reaction zone is moved for a considerable distance, for example a distance in the range 3-25 feet, more or less, radially outwardly from the well bore without further direct application of heat to the area immediately surrounding the well bore.
> (Herzog, column 2, lines 8-33).

Herzog further discloses:

> The physical characteristics and properties of the formation swept by the high temperature reaction or combustion zone and other portions of the formation otherwise influenced by the high temperature gas stream emanating from the reaction zone will probably be favorably altered with respect to oil permeability. That portion of the petroleum producing formation swept by the high temperature combustion zone will exhibit improved porosity and/or permeability values with respect to the production of petroleum therethrough. It is believed that the high temperature developed within the reaction zone will cause clays subjected thereto to lose water and otherwise become dehydrated with resulting volume shrinkage. It is also believed that some thermal fracturing of the formation swept or otherwise influenced by the high temperature reaction zone will also be accomplished, e.g., by sheer expansion of the formation along formation discontinuities and the like, leading to fractures and fissures and increasing the porosity of the formation in the portion swept by in situ combustion.
> (Herzog, column 3, lines 29-48).

Thus, Herzog does not appear to teach allowing heat to transfer from one or more heaters to a part of a formation such that a porosity of a majority of at least a portion of the part increases substantially uniformly. Applicant respectfully submits that Herzog does not appear to teach all of the features in claim 5427 and the claims dependent thereon.

In addition, many of the dependent claims are separately patentable. Amended claim 2272 describes a combination of features including: "maintaining a temperature within the selected section within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C." Applicant submits that the amended feature of claim 2272 is supported by Applicant's specification on at least page 15, line 26 to page 16, line 2 and page 122, lines 22-30. Applicant submits that the combination of features in claim 2272, in combination with the features of independent claim 2270, does not appear to be taught by the cited art.

For example, Herzog states "it is believed that the high temperatures generated at the high temperature reaction zone in the range 700-2500° F., usually in the range 800-1500° F.," (Herzog, column 3, lines 50-51). Applicant submits that Herzog does not appear to teach the combination of features in the claim, including, but not limited to, the feature of "maintaining a temperature within a selected section within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C."

Claim 2304 describes a combination of features including: "substantially uniformly increasing a permeability of a majority of the selected section." Applicant submits that the amended feature of claim 2304 is supported by Applicant's specification on at least page 22, lines 22-26. Applicant submits that the combination of features in claim 2304, in combination with the features of independent claim 2270, does not appear to be taught by the cited art for at least the reasons cited above.

F. The Claims Are Not Obvious Over Herzog Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2278-2281 and 2303 under 35 U.S.C. § 103(a) as being unpatentable over Herzog. Applicant respectfully disagrees.

To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981 (CCPA 1974), MPEP § 2143.03.

In the Office Action, the Examiner states: "The precise heating rate and thermal conductivity recited in claims 2278, 2279 are deemed obvious matters of choice or design based on, e.g., the quality and amount of the in place crude oil present in the particular petroleum formation encountered in the field." Applicant respectfully disagrees.

Claim 2278 describes a combination of features including: "controlling the heat such that

an average heating rate of the selected section is less than about 1 °C per day during pyrolysis." Applicant submits that the combination of features in claim 2278, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Claim 2279 describes a combination of features including: "wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day." Applicant submits the combination of features in claim 2279, in combination with the features of independent claim 2270, do not appear to be taught or suggested by the cited art.

Herzog discloses:

> From the above considerations it is obvious that the rate of heat energy released within the formation should be some function of the quantity of the fuel present therein, which is dependent upon the type and quantity of crude originally in place and/or combustible material or fuel caused to be deposited therein, and that the rate of release should also be dependent upon the rate at which oxygen is supplied to the combustion zone. The rate at which heat can be transferred ahead of the high temperature reaction or combustion zone should be dependent on the rate at which combustion gas leaves the reaction zone and should be to some extent dependent upon conduction through the formation itself. Accordingly, some control of the in situ combustion process can be exercised by controlling the composition, such as oxygen content, of the injected combustion supporting oxygen-containing gas.
> (Herzog, column 3, lines 12-28).

Herzog thus appears to teach or suggest that the heating rate of the formation is a function of the amount of fuel within the formation and that some control of the heating rate may be obtained by control of the combustion gas composition. Applicant submits that controlling the heat such that an average heating rate of a selected section is less than about 1 °C per day during pyrolysis is not a matter of obvious choice or design over Herzog. Herzog makes no suggestion for controlling heating of the formation to control an average heating rate below or above a selected value. In addition, Applicant submits that providing heat wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, is not a matter of obvious choice or design over Herzog. Herzog makes no suggestion for providing a selected

amount of heating energy/day to a volume of a formation.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck,* 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991), MPEP § 2143.

Applicant submits that treatment of a formation, or a portion of a formation, may be controlled (e.g., controlling the heating rate) to obtain selected results. In addition, providing a selected amount of heating energy/day to a volume of a formation may be used to obtain selected results. These methods for obtaining selected results are supported by Applicant's specification.

For example, Applicant's specification recites:

> Certain embodiments may include heating a selected volume of a hydrocarbon containing formation. Heat may be provided to the selected volume by providing power to one or more heat sources. Power may be defined as heating energy per day provided to the selected volume. A power (*Pwr*) required to generate a heating rate (*h*, in units of, for example, °C/day) in a selected volume (*V*) of a hydrocarbon containing formation may be determined by the following equation: $Pwr = h*V*C_v*\rho_B$. In this equation, an average heat capacity of the formation (C_v) and an average bulk density of the formation (ρ_B) may be estimated or determined using one or more samples taken from the hydrocarbon containing formation.
> (Specification, page 16, lines 14-22).

Applicant's specification further states:

> Certain embodiments may include controlling the heat provided to at least a portion of the formation such that production of less desirable products in the portion may be substantially inhibited. Controlling the heat provided to at least a portion of the formation may also increase the uniformity of permeability within the formation. For example, controlling the heating of the formation to inhibit production of less desirable products may, in some embodiments, include controlling the heating rate to less than a selected amount (e.g., 10 °C, 5 °C, 3 °C, 1 °C, 0.5 °C, or 0.1 °C) per day.
>
> Controlling pressure, heat and/or heating rates of a selected section in a formation may increase production of selected formation fluids. For example, the

> amount and/or rate of heating may be controlled to produce formation fluids having an American Petroleum Institute ("API") gravity greater than about 25. Heat and/or pressure may be controlled to inhibit production of olefins in the produced fluids.
> (Specification, page 17, lines 6-18).

Herzog does not appear to teach or suggest controlling heating of the formation to obtain selected results or providing a selected amount of heating energy/day to a volume of a formation to obtain selected results. Applicant respectfully submits that the Examiner's rejection of the features of claims 2278 and 2279, in combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

Claim 2280 describes a combination of features including: "allowing the heat to transfer comprises transferring heat substantially by conduction." The combination of features in claim 2280, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988), MPEP § 2143.03.

In the Office Action, the Examiner states: "The thermal conductivity recited in claim 2281 is deemed an obvious matter of choice or design based on, e.g., the quality and amount of the in place petroleum present and/or the matrix of characteristics of the particular petroleum formation encountered in the field." Applicant respectfully disagrees.

Amended claim 2281 describes a combination of features including: "providing heat

from the one or more heaters comprises heating the selected section such that a thermal conductivity of at least a portion of the selected section is greater than about 0.5 W/(m °C)." Applicant submits that the combination of features in claim 2281, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Applicant submits that providing heat from one or more heat sources such that a thermal conductivity of a portion of a formation is greater than about 0.5 W/(m °C) is unexpected based on literature in the art. For example, Applicant's specification states:

> Certain embodiments described herein will in many instances be able to economically treat formations that were previously believed to be uneconomical. Such treatment will be possible because of the surprising increases in thermal conductivity and thermal diffusivity that can be achieved with such embodiments. These surprising results are illustrated by the fact that prior literature indicated that certain hydrocarbon containing formations, such as coal, exhibited relatively low values for thermal conductivity and thermal diffusivity when heated. For example, in government report No. 8364 by J. M. Singer and R. P. Tye entitled "Thermal, Mechanical, and Physical Properties of Selected Bituminous Coals and Cokes," U.S. Department of the Interior, Bureau of Mines (1979), the authors report the thermal conductivity and thermal diffusivity for four bituminous coals. This government report includes graphs of thermal conductivity and diffusivity that show relatively low values up to about 400 °C (e.g., thermal conductivity is about 0.2 W/(m °C) or below, and thermal diffusivity is below about 1.7×10^{-3} cm^2/s). This government report states that "coals and cokes are excellent thermal insulators."
>
> In contrast, in certain embodiments described herein hydrocarbon containing resources (e.g., coal) may be treated such that the thermal conductivity and thermal diffusivity are significantly higher (e.g., thermal conductivity at or above about 0.5 W/(m °C) and thermal diffusivity at or above 4.1×10^{-3} cm^2/s) than would be expected based on previous literature such as government report No. 8364. If treated as described in certain embodiments herein, coal does not act as "an excellent thermal insulator." Instead, heat can and does transfer and/or diffuse into the formation at significantly higher (and better) rates than would be expected according to the literature, thereby significantly enhancing economic viability of treating the formation.
>
> (Specification, page 150, line 18 to page 151, line 10).

Thus, Applicant submits that providing heat from one or more heat sources heating a selected section such that a thermal conductivity of at least a portion of the selected section is

greater than about 0.5 W/(m °C) is not an obvious matter of choice or design. Applicant respectfully submits that the Examiner's rejection of the features of claim 2281, in combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

Claim 2303 describes a combination of features including: "allowing the heat to transfer comprises increasing a permeability of a majority of the selected section to greater than about 100 millidarcy." Applicant submits that the combination of features in claim 2303, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art. Applicant respectfully submits that the Examiner's rejection of the features of claim 2303 in combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

G. The Claims Are Not Anticipated by Herzog pursuant to 35 U.S.C. § 102(b); The Claims Are Not Obvious Over Herzog Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2282-2295 under 35 U.S.C. § 102(b) as being anticipated by Herzog or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Herzog. Applicant respectfully disagrees.

In the Office Action, the Examiner states: "Regarding claims 2282-2295, it is deemed that the myriad hydrocarbon product mixtures recited in these claims would necessarily or obviously occur in carrying out the in situ combustion process of Herzog, i.e., the precise

composition of the product fluids is seen as dictated by the particular petroleum or crude oil naturally occurring in the particular formation actually encountered in the field."

Applicant submits that the product mixtures recited in claims 2282-2295 would not be producible by carrying out the in situ combustion process of Herzog. The product mixtures recited in claims 2282-2295 may be produced by controlling and/or modifying formation conditions during treatment to produce the selected results recited in the claims.

For example, "Certain embodiments may include altering a composition of formation fluids produced from a hydrocarbon containing formation by altering a location of a production well with respect to a heater well." (Specification, page 18, lines 4-8). In addition, the specification states:

> In an embodiment, compositions and properties of formation fluids produced by an in situ conversion process for hydrocarbons may vary depending on, for example, conditions within a hydrocarbon containing formation. (Specification, page 17, lines 2-4).

The specification further states: "Controlling pressure, heat and/or heating rates of a selected section in a formation may increase production of selected formation fluids." (Specification, page 17, lines 14-15).

An example cited in the specification discloses:

> FIG. 112 illustrates a plot of the weight percent of specific carbon numbers of hydrocarbons within the produced hydrocarbon liquids. Curve 3620 represents the carbon distribution for the composite mixture of hydrocarbon liquids over the entire in situ conversion process ("ICP") field experiment. For comparison, a plot of the carbon number distribution for hydrocarbon liquids produced from a surface retort of the same Green River oil shale is also depicted as curve 3622. In the surface retort, oil shale was mined, placed in a vessel, rapidly heated at atmospheric pressure to a high temperature in excess of 500 °C. As illustrated in FIG. 112, a carbon number distribution of the majority of the hydrocarbon liquids produced from the ICP field experiment was within a range of 8 to 15. The peak carbon number from production of oil during the ICP field experiment was about 13. In contrast, the surface retort 3622 has a relatively flat carbon number

distribution with a substantial amount of carbon numbers greater than 25. (Specification, page 232, lines 1-12)

Applicant submits that the product mixtures recited in claims 2282-2295 would not necessarily or obviously occur in carrying out the in situ combustion process of Herzog. Thus, Applicant respectfully submits that the Examiner's rejection of claims 2282-2295 as obvious may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

H. The Claims Are Not Anticipated By Camacho et al. Pursuant To 35 U.S.C. § 102(b)

The Examiner rejected claims 2270, 2272, 2304, 2307, and 2308 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,067,390 to Camacho et al. (hereinafter "Camacho"). Applicant respectfully disagrees.

Amended claim 2270 describes a combination of features including: "allowing the heat to transfer from one or more heaters to a selected section of the formation such that a porosity of a majority of at least a portion of the selected section increases substantially uniformly." Applicant submits that Camacho does not appear to teach the combination of features in claim 2270 including, but not limited to, the feature of "allowing the heat to transfer from one or more heaters to a selected section of the formation such that a porosity of a majority of at least a portion of the selected section increases substantially uniformly."

Camacho discloses: "The heat from torch 25 first causes the volatiles to be stripped from the surrounding coal. This devolatilization results in a cracking or fracturing of the coal, thereby increasing its porosity. The devolatilization and fracturing expands radially outwardly as a heat front advances from shaft 20." (Camacho, column 7, lines 59-64). Camacho further discloses: "The diameter of the spherical voids 20'' remaining after gasification will vary with the

composition of the coal and with the amount of heat supplied; the distance maintained between adjacent shafts during drilling should be determined accordingly to provide sufficient support." (Camacho, column 9, lines 31-36).

Thus, Camacho does not appear to teach or suggest allowing the heat to transfer from one or more heaters to a selected section of the formation such that a porosity of a majority of at least a portion of the selected section increases substantially uniformly. Applicant submits Camacho does not appear to teach all of the features in claim 2270 and the claims dependent thereon.

Claim 5427 describes a combination of features including: "providing heat from one or more heaters to at least a portion of the formation, wherein one or more heaters provides a heat output of less than about 1650 watts per meter." Applicant submits that Camacho does not appear to teach the combination of features in claim 5427.

For example, Camacho discloses: "An available torch suitable for use with the present invention has an external diameter of approximately 300 millimeters and is approximately four meters long." (Camacho, column 6, lines 65-69). Camacho describes: "For example, the torch described above for use with the preferred embodiment may operate within the range of three to fifteen million Btu per hour." (Camacho, column 10, lines 35-38). Camacho further states:

> According to an illustrative mode of operation and by way of example and not limitation, the torch may be initially energized to supply heat at approximately 3 million Btu per hour to preheat the seam. After the introduction of steam for gasification, this heat input is gradually increased up to a maximum of approximately 15 million Btu per hour.
> (Camacho, column 10, lines 57-63)

Camacho appears to teach using a torch of about 4 meters in length to supply heat at about 3 million Btu per hour to about 15 million Btu per hour, or about 219,800 watts per meter to about 1,099,015 watts per meter. Thus, Applicant submits that Camacho does not appear to teach providing heat from one or more heaters to at least a portion of the formation, wherein each heater provides a heat output of less than about 1650 watts per meter. Applicant submits

Camacho does not appear to teach all of the features in claim 5427 and the claims dependent thereon.

In addition, many of the dependent claims are separately patentable. Amended claim 2272 describes a combination of features including: "maintaining a temperature within the selected section within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C." Applicant submits that the combination of features in claim 2272, in combination with the features of independent claim 2270, does not appear to be taught by Camacho.

Amended claim 2304 describes a combination of features including: "substantially uniformly increasing a permeability of a majority of at least a portion of the selected section." Applicant submits that the combination of features in claim 2304, in combination with the features of independent claim 2270, does not appear to be taught by Camacho.

Claim 2307 describes a combination of features including: "providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, and wherein the unit of heaters comprises a triangular pattern." Applicant submits that the combination of features in claim 2307, in combination with the features of independent claim 2270, does not appear to be taught by Camacho.

Claim 2308 describes a combination of features including: "providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units." Applicant submits that the combination of features in claim 2308, in combination with the features of independent claim 2270, does not appear to be taught by Camacho.

I. The Claims Are Not Obvious Over Camacho Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2278-2281, 2296-2299, 2303-2308, and 5396 under 35 U.S.C. § 103(a) as being unpatentable over Camacho. Applicant respectfully disagrees.

In the Office Action, the Examiner states: "The precise heating rate and thermal conductivity recited in claims 2278, 2279 are deemed obvious matters of choice or design based on, e.g., the quality and amount of the in place hydrocarbon present in the particular hydrocarbon formation encountered in the field, consistent with objective of Camacho to provide a low rate of heating (col. 10, lines 34-40)." Applicant respectfully disagrees.

Claim 2278 describes a combination of features including: "controlling the heat such that an average heating rate of a selected section is less than about 1 °C per day during pyrolysis." Applicant submits that the combination of features in claim 2278, in combination with the features of independent claim 2270, does not appear to be taught or suggested by Camacho.

Claim 2279 describes a combination of features including: "wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day." Applicant submits the combination of features in claim 2279, in combination with the features of independent claim 2270, do not appear to be taught or suggested by Camacho.

For at least the reasons cited above in section H of this document, Camacho does not appear to teach or suggest controlling heating of the formation to obtain selected results or providing a selected amount of heating energy/day to a volume of a formation to obtain selected results. Applicant respectfully submits that the Examiner's rejection of the features of claims 2278 and 2279, in combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought

to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

In addition, Camacho appears to teach heating the formation at a relatively high heating rate. As stated above, Camacho appears to teach using a heat output of about 219,800 watts per meter to about 1,099,015 watts per meter. Heat outputs in this range would heat a formation at a relatively rapid rate. Applicant submits that the process of Camacho could not be used to heat a formation at the heating rates suggested in claim 2278 and/or claim 2279.

Claim 2280 describes a combination of features including: "allowing the heat to transfer comprises transferring heat substantially by conduction." The combination of features in claim 2280, in combination with the features of independent claim 2270, are neither taught nor suggested by the cited art.

In the Office Action, the Examiner states: "The thermal conductivity recited in claim 2281 is deemed an obvious matter of choice or design based on, e.g., the quality and amount of the in place hydrocarbon present and/or the matrix of characteristics of the particular hydrocarbon formation encountered in the field." Applicant respectfully disagrees.

Amended claim 2281 describes a combination of features including: "providing heat from the one or more heaters comprises heating the selected section such that a thermal conductivity of at least a portion of the selected section is greater than about 0.5 W/(m °C)." Applicant submits that the combination of features in claim 2281, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

For at least the reasons cited in section H of this document, Applicant submits that providing heat from one or more heaters such that a thermal conductivity of a portion of a formation is greater than about 0.5 W/(m °C) is unexpected based on literature in the art.

Thus, Applicant submits that providing heat from one or more heaters heating a selected

C

section such that a thermal conductivity of at least a portion of the selected section is greater than about 0.5 W/(m °C) is not an obvious matter of choice or design. Applicant respectfully submits that the Examiner's rejection of the features of claim 2281, in combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner. Therefore, Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

In the Office Action, the Examiner states: "The steps of 2296-2299,2305 such as controlling the heat or pressure in the formation, are deemed obvious matters of choice or design in carrying out the process of Camacho et al. In this regard, Camacho et al teaches that steam injection temperature, pressure and/or volume may be controlled in response to monitoring of the fluid products. In addition, overall operating conditions within the hydrocarbon formation may be altered (noted col. 5, lines 20-27) to vary the product fluid composition(s)." Applicant respectfully disagrees.

Claim 2296 describes a combination of features including: "controlling a pressure within at least a majority of the selected section of the formation, wherein the controlled pressure is at least about 2.0 bar absolute." Applicant submits that the combination of features in claim 2296, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Claim 2297 describes a combination of features including: "controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H_2 within the mixture is greater than about 0.5 bar." Applicant submits that the combination of features in claim 2297, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Claim 2298 describes a combination of features including: "producing a mixture from

C

the formation, wherein a partial pressure of H_2 within the mixture is measured when the mixture is at a production well." Applicant submits that the combination of features in claim 2298, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Claim 2299 describes a combination of features including: "altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25." Applicant submits that the combination of features in claim 2299, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Claim 2305 describes a combination of features including: "controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay." Applicant submits that the combination of features in claim 2305, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Applicant submits that controlling and/or altering the pressure or heat as recited in claims 2296-2299 and 2305 provides unexpected and/or improved results based on the prior art. For example, Applicant's specification states:

> Controlling pressure, heat and/or heating rates of a selected section in a formation may increase production of selected formation fluids. For example, the amount and/or rate of heating may be controlled to produce formation fluids having an American Petroleum Institute ("API") gravity greater than about 25. Heat and/or pressure may be controlled to inhibit production of olefins in the produced fluids.
>
> Controlling formation conditions to control the pressure of hydrogen in the produced fluid may result in improved qualities of the produced fluids. In some embodiments it may be desirable to control formation conditions so that the partial pressure of hydrogen in a produced fluid is greater than about 0.5 bar absolute, as measured at a production well.
> (Specification, page 17, lines 14-23).

Applicant's specification further discloses:

In an embodiment, a pressure within a heated portion of the formation may surprisingly increase the quality of relatively high quality pyrolyzation fluids, the quantity of relatively high quality pyrolyzation fluids, and/or vapor phase transport of the pyrolyzation fluids within the formation. Increasing the pressure often permits production of lower molecular weight hydrocarbons since such lower molecular weight hydrocarbons will more readily transport in the vapor phase in the formation. Generation of lower molecular weight hydrocarbons (and corresponding increased vapor phase transport) is believed to be due, in part, to autogenous generation and reaction of hydrogen within a portion of the hydrocarbon containing formation. For example, maintaining an increased pressure may force hydrogen generated in the heated portion into a liquid phase (e.g. by dissolving). In addition, heating the portion to a temperature within a pyrolysis temperature range may pyrolyze at least some of the hydrocarbons within the formation to generate pyrolyzation fluids in the liquid phase. The generated components may include a double bond and/or a radical. H_2 in the liquid phase may reduce the double bond of the generated pyrolyzation fluids, thereby reducing a potential for polymerization of the generated pyrolyzation fluids. In addition, hydrogen may also neutralize radicals in the generated pyrolyzation fluids. Therefore, H_2 in the liquid phase may substantially inhibit the generated pyrolyzation fluids from reacting with each other and/or with other compounds in the formation. In this manner, shorter chain hydrocarbons may enter the vapor phase and may be produced from the formation.

Increasing the formation pressure to increase the amount of pyrolyzation fluids in the vapor phase may significantly reduce the potential for coking within the selected section of the formation. A coking reaction may occur in the liquid phase. Since many of the generated components may be transformed into short chain hydrocarbons and may enter the vapor phase, coking within the selected section may decrease.

Increasing the formation pressure to increase the amount of pyrolyzation fluids in the vapor phase is also beneficial because doing so permits increased recovery of lighter (and relatively high quality) pyrolyzation fluids. In general, pyrolyzation fluids are more quickly produced, with less residuals, when such fluids are in the vapor phase rather than in the liquid phase. Undesirable polymerization reactions also tend to occur more frequently when the pyrolyzation fluids are in the liquid phase instead of the vapor phase. In addition, when pyrolyzation fluids are produced in the vapor phase, fewer production wells/area are needed, thereby reducing project costs.
(Specification, page 130, line 16 to page 131, line 18).

Thus, Applicant submits that controlling and/or altering the pressure or heat as recited in claims 2296-2299 and 2305 are not obvious matters of choice or design. Applicant respectfully submits that the Examiner's rejection of the features of claims 2296-2299, and 2305, in

combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

Claim 2303 describes a combination of features including: "allowing the heat to transfer comprises increasing a permeability of a majority of the selected section to greater than about 100 millidarcy." Applicant submits that the combination of features in claim 2303, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art. Applicant respectfully submits that the Examiner's rejection of the features of claim 2303 in combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

In the Office Action, the Examiner states: "Regarding claims 2306, 2308 and 5396, Camacho et al in the embodiment of Figure 10 discloses that myriad heating wells (65) surround a production well or shaft (74). The precise number of such heating wells provided, as called for in these claims, is deemed an obvious matter of choice or design in carrying out the process of Camacho et al based on, e.g., the overall areal extent of the hydrocarbon formation(s) encountered in exploiting an actual reservoir encountered in the field." Applicant respectfully disagrees.

Claim 2306 describes a combination of features including: "producing a mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well." Applicant submits that the combination of features in claim 2306, in combination with the features of independent claim 2270, does not appear to be taught or

suggested by the cited art.

Claim 2308 describes a combination of features including: "providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units." Applicant submits that the combination of features in claim 2308, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

Claim 5396 describes a combination of features including: "wherein at least about 20 heaters are disposed in the formation for each production well." Applicant submits that the combination of features in claim 5396, in combination with the features of intervening claim 2306 and independent claim 2270, does not appear to be taught or suggested by the cited art.

Applicant submits that the number of heaters provided for a production well may be selected based on various factors including, but not limited to, producing selected products and/or compositions from a formation. For example, Applicant's specification states:

> A ratio of heat sources to production wells may vary, however, depending on, for example, the desired heating rate of the hydrocarbon containing formation, the heating rate of the heat sources, the type of heat source, the type of hydrocarbon containing formation, the composition of hydrocarbon containing formation, the desired composition of the produced fluid, and/or the desired production rate. Providing more heat sources wells per unit area will allow faster heating of the selected portion and thus hastening the onset of production, however more heat sources will generally cost more money to install. An appropriate ratio of heat sources to production wells may also include ratios greater than about 5:1, and ratios greater than about 7:1. In some embodiments an appropriate ratio of heat sources to production wells may be about 10:1, 20:1, 50:1 or greater. If larger ratios are used, then project costs tend to decrease since less wells and equipment are needed.
> (Specification, page 72, lines 19-30)

To the contrary, Camacho discloses:

> Shaft 74 serves as a common conduit for pumping of oil from a large number of reservoirs which are being filled in the same field. In the alternative, a single slanted hole 75 (as shown in dashed lines) may be drilled to the reservoir at the bottom of each replacement hole for pumping the crude oil to the surface. The common vertical shaft technique is preferable for large fields whereas the single slanted hole technique could be preferable for smaller fields.
> (Camacho, column 12, lines 55-63)

Camacho appears to teach selecting a method for collecting fluids from a reservoir based upon the size of the reservoir. Camacho does not provide any suggestion or motivation for selecting a specific number of shafts or slanted holes. Additionally, Camacho does not suggest or provide motivation for selecting the number of shafts or slanted holes based upon any criteria other than the size of the field.

Applicant submits that the selection of the number of heater wells provided for a production well is not an obvious matter of choice or design but, rather, may be based upon non-obvious choices such as desired product composition, desired production rates, desired heating rates, etc. Applicant respectfully submits that the Examiner's rejection of the features of claims 2306, 2308, and 5396, in combination with the features of independent claim 2270, as obvious matters of choice or design may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply. Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

J. The Claims Are Not Anticipated by Camacho pursuant to 35 U.S.C. § 102(b); The Claims Are Not Obvious Over Camacho Pursuant To 35 U.S.C. § 103(a)

The Examiner rejected claims 2282-2295 under 35 U.S.C. § 102(b) as being anticipated by Camacho or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Camacho.

Applicant respectfully disagrees.

In the Office Action, the Examiner stated: "Regarding claims 2282-2295, it is deemed that the myriad hydrocarbon product mixtures recited in these claims would necessarily or obviously occur in carrying out the heating process of Camacho et al, i.e., the precise composition of the product fluids is seen as dictated by the particular hydrocarbon naturally occurring in the particular formation actually encountered in the field."

Applicant submits that the product mixtures recited in claims 2282-2295 would not be producible by carrying out the heating process of Camacho. The product mixtures recited in claims 2282-2295 may be produced by controlling and/or modifying formation conditions during treatment to produce the selected results recited in the claims.

For example, "Certain embodiments may include altering a composition of formation fluids produced from a hydrocarbon containing formation by altering a location of a production well with respect to a heater well." (Specification, page 18, lines 4-8). In addition:

> Certain embodiments may include providing a reducing agent to at least a portion of the formation. A reducing agent provided to a portion of the formation during heating may increase production of selected formation fluids. A reducing agent may include, but is not limited to, molecular hydrogen. For example, pyrolyzing at least some hydrocarbons in a hydrocarbon containing formation may include forming hydrocarbon fragments. Such hydrocarbon fragments may react with each other and other compounds present in the formation. Reaction of these hydrocarbon fragments may increase production of olefin and aromatic compounds from the formation. Therefore, a reducing agent provided to the formation may react with hydrocarbon fragments to form selected products and/or inhibit the production of non-selected products.
> (Specification, page 21, lines 17-26).

Applicant submits that the product mixtures recited in claims 2282-2295 would not necessarily or obviously occur in carrying out the heating process of Camacho. Thus, Applicant respectfully submits that the Examiner's rejection of claims 2282-2295 as obvious may rely upon personal knowledge of the Examiner and therefore Applicant believes MPEP 2144.03 will apply.

Pursuant to MPEP 2144.03, Applicant respectfully requests the Examiner to provide support for his assertion either by an affidavit or by references brought to the Applicant's attention. Otherwise, Applicants request this rejection be removed. *See, e.g.,* MPEP 2143.01.

K. The Claims Are Not Obvious Over Camacho Pursuant To 35 U.S.C. § 103(a) And Further In View of Hoekstra et al. or Garrett

The Examiner rejected claim 2302 as being unpatentable under 35 U.S.C. § 103(a) over Camacho as applied to claim 2270, and further in view of U.S. Patent No. 4,353,418 to Hoekstra et al. ("Hoekstra") or U.S. Patent No. 3,661,423 to Garrett ("Garrett"). Applicant respectfully disagrees.

Claim 2302 describes a combination of features including: "producing hydrogen and condensable hydrocarbons from the formation; and hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen." The combination of features in claim 2302, in combination with the features of independent claim 2270, does not appear to be taught or suggested by the cited art.

If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988), MPEP § 2143.03.

L. The New Claims Are Not Anticipated or Obvious in view of the Cited Art

Claim 5397 describes a combination of features including: "providing heat from one or more heaters to at least a portion of the formation; and allowing the heat to transfer from one or more heaters to a part of the formation such that a porosity of a majority of the part increases substantially uniformly." Applicant submits that the cited art does not appear to teach or suggest all of the features in claim 5397 and the claims dependent thereon.

Claim 5427 describes a combination of features including: "providing heat from one or more heaters to at least a portion of the formation, wherein one or more heaters provides a heat output of less than about 1650 watts per meter; and allowing the heat to transfer from the one or more heaters to a part of the formation such that a porosity of a majority of at least a portion of the part increases substantially uniformly." Applicant submits that the cited art does not appear to teach or suggest all of the features in claim 5427 and the claims dependent thereon.

Claim 5436 describes a combination of features including: "providing heat from one or more heaters to at least a portion of the formation; and allowing the heat to transfer from one or more heaters to a part of the formation such that an assessed porosity of any portion of the part does not vary by more than about 25 % from an assessed average porosity of the part." Applicant believes claim 5406 is supported by Applicant's specification. The feature "wherein an assessed porosity of any portion of the part does not vary by more than about 25 % from an assessed average porosity of the pyrolysis zone " is described at least at page 153, lines 6-9 of Applicant's specification. For at least the reasons cited above for claim 2270, Applicant submits that the cited art does not appear to teach or suggest all of the features in claim 5436 and the claims dependent thereon.

Claim 5445 describes a combination of features including: "allowing the heat to transfer from at least two heaters to a part of the formation such that superposition of heat from at least two heaters pyrolyzes at least some hydrocarbons within the part and increases porosity in the part." Claim 5445 includes features from claim 2270 and claim 2271 substantially written independent form. Applicant submits that the cited art does not appear to teach or suggest all of the features in claim 5445 and the claims dependent thereon.

M. Prior Art Made of Record

In the Office Action, the Examiner states "Of the cited references, it is noted that Tsai et al (4,299,285), Ljungstrom (2,923,535), Bridges et al (4,144,935) and Stresty et al (4,485,869) also disclose processes for increasing the porosity of a hydrocarbon formation via heating, and

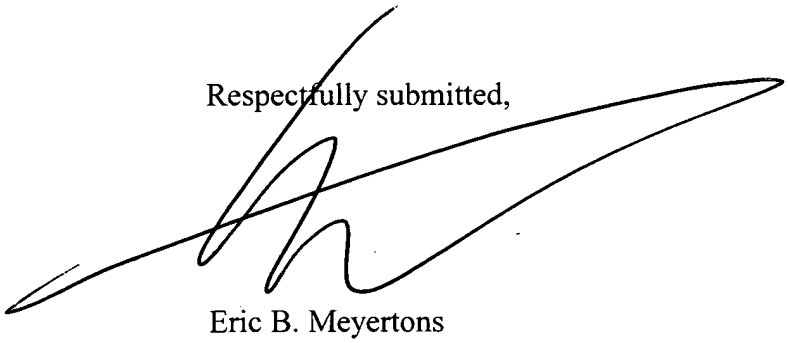
are thus cumulative to the references applied above against claim 2270." Applicant respectfully disagrees. For at least the reasons cited above in sections E through K of this document, Applicant submits that the cited art does not teach or suggest the features of claims 2270, 5397, 5406, 5412, 5421 and the claims dependent thereon.

N. Conclusion

Applicant believes that the pending claims are allowable over the cited art. Favorable reconsideration is respectfully requested.

A Fee Authorization in the amount of $1194.00 is enclosed to cover fees for the added claims. Applicant respectfully requests a two-month extension of time to respond to the office action mailed April 18, 2002. A Fee Authorization that includes $400.00 for the two-month extension of time fee is enclosed. If any further extension of time is required, Applicant hereby respectfully requests the appropriate extension of time. If any fees are inadvertently omitted or have been overpaid, please charge or credit those fees to Conley, Rose & Tayon, P.C. Deposit Account Number 501505/5659-02500/EBM.

Respectfully submitted,



Eric B. Meyertons
Reg. No. 34,876

Attorney for Applicant

CONLEY, ROSE & TAYON, P.C.
P.O. BOX 398
AUSTIN, TX 78767-0398
(512) 703-1254 (voice)
(512) 703-1250 (facsimile)

Date: 9/5/02

Marked Up Version of Amendments

Submitted with Response to Office Action mailed April 18, 2002

In the Specification:

On page 38, the paragraph beginning on line 16:

"Hydrocarbons" are generally defined as ~~organic material that contains carbon and hydrogen in their molecular structures~~molecules formed primarily by carbon and hydrogen atoms. Hydrocarbons may also include other elements, such as, but not limited to, halogens, metallic elements, nitrogen, oxygen, and/or sulfur. Hydrocarbons may be, but are not limited to, kerogen, bitumen, pyrobitumen, and oils. Hydrocarbons may be located within or adjacent to mineral matrices within the earth. Matrices may include, but are not limited to, sedimentary rock, sands, silicilytes, carbonates, diatomites, and other porous media.

On page 64, the paragraph beginning on line 11:

As shown in FIG. 3, in addition to heat sources 100, one or more production wells ~~102~~ 104 will typically be disposed within the portion of the coal formation. Formation fluids may be produced through production well 104. ~~Production well 102 may be configured such that a mixture that may include formation fluids may be produced through the production well.~~ Production well ~~102~~ 104 may also include a heat source. In this manner, the formation fluids may be maintained at a selected temperature throughout production, thereby allowing more or all of the formation fluids to be produced as vapors. Therefore, high temperature pumping of liquids from the production well may be reduced or substantially eliminated, which in turn decreases production costs. Providing heating at or through the production well tends to: (1) ~~prevent~~ inhibit condensation and/or refluxing of production fluid when such production fluid is moving in the production well

proximate to the overburden, (2) increase heat input into the formation, and/or (3) increase formation permeability at or proximate the production well.

In the Claims:

2270. (Amended) A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more ~~heat sources~~ heaters to at least a portion of the formation; and

allowing the heat to transfer from ~~the~~ one or more ~~heat sources~~ heaters to a selected section of the formation such that a porosity of a majority of at least a portion of the selected section increases substantially uniformly.

2271. (Amended) The method of claim 2270, wherein the one or more ~~heat sources~~ heaters comprise at least two ~~heat sources~~heaters, and wherein superposition of heat from at least ~~the~~ two ~~heat sources~~ heaters pyrolyzes at least some hydrocarbons within the selected section of the formation.

2272. (Amended) The method of claim 2270, further comprising maintaining a temperature within the selected section within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C.

2273. (Amended) The method of claim 2270, wherein the one or more ~~heat sources~~ heaters comprise electrical heaters.

2274. (Amended) The method of claim 2270, wherein the one or more ~~heat sources~~ heaters comprise surface burners.

2275. (Amended) The method of claim 2270, wherein the one or more ~~heat sources~~ heaters comprise flameless distributed combustors.

2276. (Amended) The method of claim 2270, wherein the one or more ~~heat sources~~ heaters comprise natural distributed combustors.

2279. (Amended) The method of claim 2270, wherein providing heat from the one or more ~~heat sources~~ heaters to at least the portion of formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more heat sources, wherein the formation has an average heat capacity (Cv), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day *(Pwr)* provided to the selected volume is equal to or less than ~~*Pwr*, wherein *Pwr* is calculated by the equation:~~

~~$Pwr = h*V*C_v*\rho_B$~~

~~wherein *Pwr* is the heating energy/day, *h* is an average heating rate of the formation, ρ_B~~ is formation bulk density, and wherein ~~the~~ an average heating rate *(h)* of the selected volume is ~~less than~~ about 10 °C/day.

2281. (Amended) The method of claim 2270, wherein providing heat from the one or more ~~heat sources~~ heaters comprises heating the selected section such that a thermal conductivity of at least a portion of the selected section is greater than about 0.5 W/(m °C).

2293. (Amended) The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

2304. (Amended) The method of claim 2270, ~~wherein allowing the heat to transfer comprises~~further comprising substantially uniformly increasing a permeability of a majority of the selected section.

2306. (Amended) The method of claim 2270, further comprising producing a mixture in a production well, and wherein at least about 7 ~~heat sources~~ heaters are disposed in the formation for each production well.

2307. (Amended) The method of claim 2270, further comprising providing heat from three or more ~~heat sources~~ heaters to at least a portion of the formation, wherein three or more of the ~~heat sources~~ heaters are located in the formation in a unit of heat sources, and wherein the unit of ~~heat sources~~ heaters comprises a triangular pattern.

2308. (Amended) The method of claim 2270, further comprising providing heat from three or more ~~heat sources~~ heaters to at least a portion of the formation, wherein three or more of the ~~heat sources~~ heaters are located in the formation in a unit of heat sources, wherein the unit of ~~heat sources~~ heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

5396. (Amended) The method of claim 2306, wherein at least about 20 ~~heat sources~~ heaters are disposed in the formation for each production well.